COURSE NUMBER: Vk250	**COURSE TITLE:** Principles of Engineering Materials
TERMS OFFERED: Spring **CREDIT: 4**	**PREREQUISITES:** Vc210 or equivalent
TEXTBOOKS/REQUIRED MATERIAL: William Callister, Materials Science and Engineering: An Introduction,9th Ed. ISBN: 978-0-470-41997-7	**PREPARED BY:** Qianli Chen **DATE OF PREPARATION:** December 18, 2018 **DATE OF UC APPROVAL:**
INSTRUCTOR(S): Qianli Chen	**SCIENCE/DESIGN:** science
CATALOG DESCRIPTION: Introductory course to engineering materials. Properties (mechanical, thermal and electrical) of metals, polymers, ceramics, and electronic materials. Correlations of these properties with: (1) their internal structures (atomic, molecular, crystalline, micro-and macro); (2) service conditions (mechanical, thermal, chemical, electrical, magnetic and radiation); and (3) processing.	**COURSE TOPICS:** 1. Atomic bonding, crystallography, defects 2. Diffusion 3. Mechanical properties, strengthening mechanisms 4. Failure of materials and engineering components 5. Phase diagrams 6. Microstructural design of materials 7. Polymers 8. Corrosion 9. Electrical, magnetic, optical properties 10. Case studies
COURSE STRUCTURE/SCHEDULE: Lecture: three times per week, 90 minutes each	

COURSE OBJECTIVES [Course Outcomes in brackets]	1. To teach students the elementary relationships between structure, properties, processing and performance of materials that are essential for understanding the role of materials in the design of engineering systems. [1,2,3,4,5,6,7,8,9,10] 2. To introduce students to the various classes of materials (metals, ceramics, polymers, semiconductors, composites) and their fundamental chemical and structural nature. [1,2,3,4,5,6,7,8,9,10] 3. To illustrate application of thermodynamics (through phase diagrams) and kinetics (through diffusion) to the design of materials and their properties. [3,6,7,8] 4. To introduce students to the functional properties of materials and the roles of microstructure, defects and environment play in typical engineering applications. [1,2,3,4,5,6,7,8,9,10] 5. To stimulate student interest in and appreciation of Materials Science and Engineering by critical examination of engineering case studies, such as the materials design of hip prostheses, shuttle tiles, bicycles and electronic devices. [1,2,3,4,5,6,7,8,9,10]
COURSE OUTCOMES [Student Outcomes in brackets]	1. Using concepts of inter-atomic bonding, be able to predict fundamental physical properties (thermal expansion, melting temperature, and modulus) of different classes of materials. [1,2,7] 2. Given a particular crystal structure, determine the crystallographic directions and planes, and the linear and planar atomic densities. 3. Using principles of diffusion theory and tabulated data, calculate the temperature needed to diffuse B into Si or C into Fe such that a desired solute concentration is attained at a prescribed distance beneath the surface in a practical diffusion time. [1,2,7] 4. Given data on strength versus cold work for an alloy, calculate the final diameter of a drawn rod that will have a prescribed cold-worked strength. [1,2,7] 5. Given data on fracture toughness, mechanical strength and loading configuration of a material component, calculate the maximum tolerable flaw size within a practical safety factor. [1,2,7] 6. Given a binary phase diagram and a particular alloy composition at a given temperature, determine the phases expected to be present, and calculate their compositions and the volume fraction of each phase. [7] 7. Given a binary eutectic phase diagram, determine the microstructures expected for various alloy compositions cooled from the melt at different cooling rates. [7] 8. Using the concept of a TTT diagram, determine the heat treatment of a eutectoid steel required to produce a specified strength, hardness and ductility. [1,2] 9. Given experimental data of the temperature dependence of the electrical conductivity of an extrinsic semiconductor, determine the position of the acceptor or donor levels and the band gap. [7] 10. Given the structure and chemistry of a piezelectric ceramic, calculate the strain required to generate a desired voltage for a particular application. [1,2,7]
ASSESSMENT TOOLS [Course Outcomes in brackets]	In-class quizzes [1,2,3,4,5,6,7,8,9,10] Homework [1,2,3,4,5,6,7,8,9,10] Midterm Exam [1,2,3,4,5] Final Exam [6,7,8, 9,10]